



Florida Power & Light Company, 6501 S. Ocean Drive, Jensen Beach, FL 34957

November 24, 2004


L-2004-270
10 CFR § 50.73

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D. C. 20555

Re: St. Lucie Units 1 and 2
Docket Nos. 50-335 and 50-389
Reportable Event: 2004-004-00
Date of Event: September 25, 2004
Dual Unit Loss Of Offsite Power During Hurricane Jeanne

The attached Licensee Event Report 2004-004 is being submitted pursuant to the requirements of 10 CFR § 50.73 to provide notification of the subject event.

Very truly yours,


William Jefferson, Jr.
Vice President
St. Lucie Nuclear Plant

WJ/KWF
Attachment

LICENSEE EVENT REPORT (LER)

(See reverse for required number of
digits/characters for each block)

Estimated burden per response to comply with this mandatory collection request: 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records and FOIA/Privacy Service Branch (T-5 F52), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

1. FACILITY NAME

St. Lucie Unit 1

2. DOCKET NUMBER

05000335

3. PAGE

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4. TITLE

Dual Unit Loss Of Offsite Power During Hurricane Jeanne

5. EVENT DATE

MONTH	DAY	YEAR
09	25	2004

6. LER NUMBER

REVISION NUMBER
2004 - 004 - 00

7. REPORT DATE

MONTH	DAY	YEAR
11	24	2004

8. OTHER FACILITIES INVOLVED

FACILITY NAME	DOCKET NUMBER
St. Lucie Unit 2	05000389
FACILITY NAME	DOCKET NUMBER

9. OPERATING MODE

4

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply)

- | | | | |
|---|---|--|---|
| <input type="checkbox"/> 20.2201(b) | <input type="checkbox"/> 20.2203(a)(3)(i) | <input type="checkbox"/> 50.73(a)(2)(i)(C) | <input type="checkbox"/> 50.73(a)(2)(vii) |
| <input type="checkbox"/> 20.2201(d) | <input type="checkbox"/> 20.2203(a)(3)(ii) | <input type="checkbox"/> 50.73(a)(2)(ii)(A) | <input type="checkbox"/> 50.73(a)(2)(viii)(A) |
| <input type="checkbox"/> 20.2203(a)(1) | <input type="checkbox"/> 20.2203(a)(4) | <input type="checkbox"/> 50.73(a)(2)(ii)(B) | <input type="checkbox"/> 50.73(a)(2)(viii)(B) |
| <input type="checkbox"/> 20.2203(a)(2)(i) | <input type="checkbox"/> 50.36(c)(1)(i)(A) | <input checked="" type="checkbox"/> 50.73(a)(2)(iii) | <input type="checkbox"/> 50.73(a)(2)(ix)(A) |
| <input type="checkbox"/> 20.2203(a)(2)(ii) | <input type="checkbox"/> 50.36(c)(1)(ii)(A) | <input checked="" type="checkbox"/> 50.73(a)(2)(iv)(A) | <input type="checkbox"/> 50.73(a)(2)(x) |
| <input type="checkbox"/> 20.2203(a)(2)(iii) | <input type="checkbox"/> 50.36(c)(2) | <input type="checkbox"/> 50.73(a)(2)(v)(A) | <input type="checkbox"/> 73.71(a)(4) |
| <input type="checkbox"/> 20.2203(a)(2)(iv) | <input type="checkbox"/> 50.46(a)(3)(ii) | <input type="checkbox"/> 50.73(a)(2)(v)(B) | <input type="checkbox"/> 73.71(a)(5) |
| <input type="checkbox"/> 20.2203(a)(2)(v) | <input type="checkbox"/> 50.73(a)(2)(i)(A) | <input type="checkbox"/> 50.73(a)(2)(v)(C) | <input type="checkbox"/> OTHER |
| <input type="checkbox"/> 20.2203(a)(2)(vi) | <input type="checkbox"/> 50.73(a)(2)(i)(B) | <input type="checkbox"/> 50.73(a)(2)(v)(D) | Specify in Abstract below or in NRC Form 366A |

10. POWER LEVEL

000

12. LICENSEE CONTACT FOR THIS LER

NAME

Kenneth W. Frehafer, Licensing Engineer

TELEPHONE NUMBER (Include Area Code)

(772) 467 - 7748

13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX
X	BI	HS	G080	YES	X	EK	2	A160	YES

14. SUPPLEMENTAL REPORT EXPECTED

YES
(If yes, complete EXPECTED SUBMISSION DATE).

X

NO

15. EXPECTED SUBMISSION DATE

MONTH	DAY	YEAR
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ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)

At 2356 hours on September 25, 2004, a dual-unit LOOP occurred at the St. Lucie site. Earlier that day both units commenced an orderly shutdown to prepare for the arrival of Hurricane Jeanne. At the time of the LOOP, the site was experiencing hurricane force winds with both units in Mode 4. The emergency diesel generators started and safe shutdown loads (with the exception of the 1B intake cooling water pump) were sequenced as designed. Offsite power was restored to both units by 1103 hours on September 26, 2004.

The LOOP was caused by two independent electrical faults associated with the wind-driven salt contamination in the westward eye wall of Hurricane Jeanne. However, with both units shutdown, the switchyard design protection scheme for the main generators effectively reduces electrical power redundancy to the startup transformers.

Site damage assessment and recovery efforts continued and both units were returned to service by October 4, 2004. The control switch and load-sequencing relay for the 1B ICW pump were replaced. FPL is evaluating long-term options to restore the switchyard redundancy to the startup transformers when a unit is taken off-line.

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TEXT (If more space is required, use additional copies of NRC Form 366A) (17)

Description of the Event

In the late evening hours of September 25, 2004, St. Lucie Units 1 and 2 were shutdown in Mode 4 as the effects of Hurricane Jeanne, a Category 3 hurricane on the Saffir-Simpson scale, were experienced at the site. Earlier that day both units were taken off-line, as required by the St. Lucie emergency plan implementing procedures, prior to the onset of hurricane force winds at the site.

The arrangement of the St. Lucie switchyard [EIIS:FK] is presented in Figure 1. The four bay 230 kV (nominal) switchyard provides switching capability for two main generator outputs, four startup transformers, three outgoing transmission lines, and one distribution substation. The three outgoing transmission lines are identified as Midway 1, 2, and 3 and service switchyard Bays 1, 2, and 3, respectively. The Hutchinson Island distribution substation is serviced by Bay 4. The main generators for both St Lucie Units 1 and 2 produce power and that enters the switchyard in Bays 1 and 3, respectively.

Bay 2 (Midway 2) supplies power to startup transformers 1A and 2A, located in the St Lucie Unit 1 transformer yard. Bay 4 (Hutchinson Island distribution substation) supplies power to startup transformers 1B and 2B located in the St. Lucie Unit 2 transformer yard. During normal operation, either set of startup transformers can be fed from any one of the incoming transmission lines through all of the east-west switchyard bus cross-ties. However, when a unit is taken off-line, the switchyard design requires removal of the cross-tie between the east and west 230kV busses. To remove a unit from service, the generator breakers (8W30 and 8W26 in Bay 1 for Unit 1 or 8W52 and 8W49 in Bay 3 for Unit 2) must be opened and remain open to isolate the main transformer lines. Since both units are removed from service in anticipation of hurricane force winds, two bays between the east and west busses are lost such that the startup transformers are serviced by the two remaining east-west cross-ties in Bays 2 and 4.

At 1100 hours on September 25, 2004, Unit 1 was removed from service followed by Unit 2 at 1159 hours. Later the same day Unit 1 entered Mode 4 at 1840 hours followed by Unit 2 at 2036 hours. At 2221 hours, a fault in the Hutchinson Island distribution substation feed caused the west bus breaker 8W67 [EIIS:FK:BRK] and mid breaker 8W64 [EIIS:FK:BRK] to open in Bay 4. At this time, the 1A/2A startup transformers [EIIS:EA:XMFR] were still connected to the east and west switchyard busses in Bay 2, but in Bay 1 the 1B/2B startup transformers [EIIS:EA:XMFR] were only connected to the east switchyard bus. By 2349 hours, Unit 1 completed the transition to shutdown cooling as the decay heat removal mechanism, but Unit 2 was still removing decay heat by steaming to the steam generators. At 2356 hours, a fault on the Midway 2 feed to Bay 2 opened the west bus breaker 8W43 [EIIS:FK:BRK] and the mid breaker 8W40 [EIIS:FK:BRK], and power to the east switchyard bus was lost causing a complete loss of offsite power (LOOP) at both units (although Midway lines 1 and 3 remained energized, they were only capable of powering the west switchyard bus and the east-west cross-ties in Bays 2 and 4 were lost with the faults on the Hutchinson Island distribution substation and Midway 2 feeds). As described later, all four of the emergency diesel generators (EDGs) [EIIS:EK:DG] started in response the LOOP conditions and safe shutdown loads were sequenced onto each unit's safety busses. At 0004 hours on September 26, 2004, power to the Midway 2 line was restored. However, the decision was made to not restore power to the startup transformers until weather conditions improved enough to permit switchyard inspections.

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By 0800 hours on September 26, 2004, weather conditions had improved sufficiently and switchyard inspections commenced. At 1009 hours, offsite power was restored to all of the Unit 2 electrical busses. At 1103 hours, offsite power was restored to all of the Unit 1 electrical busses. Damage assessment and hurricane recovery plans continued and St. Lucie Unit 1 was returned to service on October 3, 2004, followed by the return to service of Unit 2 on October 4, 2004.

The units' responses to the LOOPS were as follows:

On Unit 1, all safety systems responded to the LOOP as required, except the 1B intake cooling water (ICW) pump [EIIS:BI:P] failed to automatically load onto its respective EDG. Shutdown cooling flow to the "A" train was restored at 0004 hours when the 1A low pressure safety injection (LPSI) pump [EIIS:BP:P] was restarted on EDG power. The 1B ICW pump was manually started at 0040 hours.

On Unit 2, all safety systems responded to the LOOP as required, except that the 2A1 EDG fuel day tank solenoid valve failed to open such that the fuel day tank level had to be manually controlled by local operation. At 0245 hours, decay heat removal was transitioned to shutdown cooling when the "A" train of shutdown cooling was placed in service.

Cause of the Event

The faults that resulted in the dual unit LOOP at the St. Lucie site were most likely caused by salt contamination on electrical components as a result of the extreme environmental conditions experienced during Hurricane Jeanne. The west side of the eye wall was heavily contaminated with salt spray, creating the potential for electrical faults. This salt spray contamination was removed by the east side of eye wall as it washed the salt away with cleaner water. This west eye wall salt spray contamination - east eye wall self cleaning phenomenon was also observed in substations throughout the FPL service territory.

An additional cause for the LOOP is that the switchyard design requires removal of each unit's east and west 230kV bus cross-tie when the unit is off-line. If the switchyard design had non-load interrupting disconnect switches (NLIDS) in the main transformer lines, Bays 1 and 3 would provide additional cross-ties between the east and west 230kV busses. This would allow re-closing the generator breakers (8W30 and 8W26 in Bay 1 for Unit 1 or 8W52 and 8W49 for Unit 2 in Bay 3) when a St. Lucie unit is off-line. This design would result in a more robust 230kV switchyard when challenged by extreme environmental conditions.

The FPL investigation determined that the failure of the 1B ICW pump to automatically load on the EDG was isolated to the control signals to the 4.16kV breaker and not the breaker mechanism itself. Further troubleshooting determined that the most likely cause was the intermittent failure of either the 1B ICW pump control switch [EIIS:BI:HS] or the load-sequencing relay [EIIS:EK:2]. As a conservative action both the 1B ICW control switch and load-sequencing relay were replaced.

Troubleshooting the 2A EDG fuel day tank fuel solenoid valve determined that the most likely cause was an intermittent failure in the solenoid valve control circuitry of either the RHH1 day tank hi-hi level relay or the "Gems Flip Pack A" solid-state controller. As a conservative action both components were replaced.

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Analysis of the Event

This event is reportable in accordance with 10 CFR 50.73(a)(2)(iv)(A) due to the automatic actuation of the emergency AC electrical power systems.

Additionally, this event is also being reported in accordance with 10 CFR 50.73(a)(2)(iii) as a natural phenomenon that significantly hampered the ability of site personnel to safely operate the nuclear power plants. During the hurricane all the required actions to maintain the units in safe shutdown conditions took place within sheltered areas. However, weather conditions did hamper the restoration of offsite power to the units' electrical busses. Therefore, during the hurricane, safe shutdown loads remained connected to the EDGs even after power was capable of being restored to the east electrical switchyard busses because conditions would not allow personnel to safely inspect the switchyard.

Analysis of Safety Significance

A review of the relay actions shows that the switchyard system protection operated properly. The protection disconnected transmission circuits from the switchyard busses when the integrity of the circuits was challenged by the environmental conditions present during Hurricane Jeanne. Storm preparations included briefing the operating crews on the possibility of a LOOP. The operators were prepared for losing the reactor coolant pumps and took appropriate action on natural circulation while the units were transitioned to shutdown cooling. There was no significant equipment problems noted while maintaining shutdown conditions during the hurricane. Additionally, although no attempt was made to restore offsite power to the startup transformers during the hurricane, if EDG power was lost, offsite power could have been restored through Bay 2. Based on the above, this event did not have a significant effect on the health and safety of the public.

Corrective Actions

1. No immediate corrective action related to salt contamination was required since the post-storm testing demonstrated that the switchyard insulation was clean.
2. The 1B ICW pump load-sequencing relay was replaced under work order 34016797 and the 1B ICW pump control switch was replaced under work order 34016797.
3. The 2A EDG Day Tank RHH1 relay and the solid-state controller were replaced under work order 34016818.
4. St. Lucie is considering replacing the disconnect links between the switchyard and the main transformers of each St. Lucie unit with motor operated disconnect (MOD) switches or evaluate other means of improving switchyard reliability. This assessment will be completed by May 1, 2005.

Additional Information

None

Failed Components Identified

Component: CS-833 - 1B ICW pump pull to lock control switch
Manufacturer: General Electric Co.
Model Number: 16SBMD4D09T1F1P1

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Component: 2X/TDPU - 1B ICW pump load-sequencing relay
 Manufacturer: Allen Bradley
 Model Number: 700-RT11C200Z1

Similar Events

None

Figure 1 - St. Lucie Switchyard Arrangement

